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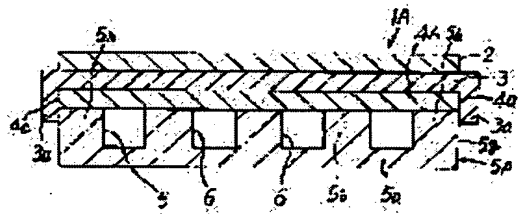
(54) CELL FOR SOLID ELECTROLYTE FUEL CELL AND POWER GENERATING DEVICE USING IT

(57)Abstract:
PURPOSE: To increase an amount of generation per unit volume of a solid electrolyte fuel cell, the strength of a cell, the reliability of the cell and its stack and the productivity of the cell.
CONSTITUTION: A separator 5A is composed of an electron conductor of compactness. A pair of side walls 5h are provided on the surface of a cross direction edge part of a plane quadrilateral plate-like body 5a, and a partition wall 5b is provided therebetween, and a path 6 for an oxide gas to flow is provided between a pair of side walls 5h. An air electrode 4 is connected to the paired side walls 5h and the partition wall 5b, so that the path for the oxide gas to flow is covered. The compact solid electrolyte 3 covers the surface of the air electrode 4 and the cross direction side face and besides covers the outer wall face 5g of the side wall 5h of the separator. A fuel electrode 2 is provided on the surface of the solid electrolyte 3.



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* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] The front face and the crosswise side face of this air electrode are covered. separator; which consisted of an electronic conductor of the substantia compacta and equips the front face of the crosswise edge of a plate-like plane quadrilateral-like body with the side attachment wall of a pair -- air electrode; joined to said side attachment wall of this separator -- And it has the fuel electrode in which a part of skin of the side attachment wall of said separator was prepared on solid electrolyte [of a wrap and the substantia compacta];, and the front face of this solid electrolyte. The cell of a solid oxide fuel cell with which a conductive septum is formed in the space surrounded with said plate-like body, side attachment wall of said pair, and said air electrode, an oxidation gas passageway is formed, and said septum is combined to said plate-like body and said air electrode.
[Claim 2] The cell of a solid oxide fuel cell according to claim 1 said whose electronic conductor is the electronic conduction nature ceramics.
[Claim 3] The thickness of said solid electrolyte is 10 micrometers. It is 500 above. mum Cell of a solid oxide fuel cell according to claim 1 which is the following.
[Claim 4] The cell of a solid oxide fuel cell according to claim 1 whose ratio of the die length of a long side to the die length of the shorter side the flat-surface configuration of said solid electrolyte is a rectangle, and is more than twice.
[Claim 5] the cross section which was formed so that said oxidation gas passageway might be prolonged in said long side and parallel, and cut said oxidation gas passageway crosswise [the] -- 0.01-2cm2 it is -- cell of a solid oxide fuel cell according to claim 4.
[Claim 6] The cell of a solid oxide fuel cell according to claim 1 with which a edge side septum is formed in one edge of the die-length direction of said separator, the end of said oxidation gas passageway is blockaded by this, the other end of this oxidation gas passageway carries out opening, said edge side septum and said air electrode touch, and a part of side face by the side of one [said] edge of this air electrode and skin of said edge side septum are covered with said solid electrolyte.
[Claim 7] The cell of a solid oxide fuel cell according to claim 1 through which said oxidation gas passageway carried out opening, and said oxidation gas passageway has flowed among the both ends of the die-length direction of this separator in the both ends of the die-length direction of said separator.
[Claim 8] The cell of a solid oxide fuel cell according to claim 7 which said oxidation gas passageway is an abbreviation straight line-like, and has been mutually prolonged from the end of the die-length direction of said separator in parallel to the other end.
[Claim 9] The cell of a solid oxide fuel cell according to claim 7 with which the abbreviation straight-line-like oxidation gas passageway is mutually formed in parallel in the generation-of-electrical-energy part among cells, and an oxidation gas passageway sees superficially and is crooked in the preheating part for heating oxidation gas beforehand among cells.
[Claim 10] A cell according to claim 1 keeps two or more predetermined spacing mutually, and is arranged, and it is arranged so that the fuel electrode of the cell of the plurality in this case and the sense of opening may become almost the same. Series connection is carried out with the heat-resistant conductor of the structure where the fuel electrode and separator of an adjacent cell do not bar gaseous circulation. The power plant constituted so that fuel gas could be supplied to said generation-of-electrical-energy interior of a room, while parallel connection is carried out and supplying oxidation gas in the oxidation gas passageway of a cell with the heat-resistant conductor of the structure where the separators of an adjacent cell do not bar gaseous circulation.
[Claim 11] The power plant according to claim 10 with which said heat-resistant conductor consists of felt-like matter made from nickel, or sponge-like matter made from nickel.
[Claim 12] A fuel gas room, a generator room, a combustion chamber, and an oxidation gas chamber are

prepared at least in a power plant. A cell according to claim 6 keeps two or more predetermined spacing mutually, and is arranged, and it is arranged so that the fuel electrode of the cell of the plurality in this case and the sense of opening may become almost the same. Series connection is carried out with the heat-resistant conductor of the structure where the fuel electrode and separator of an adjacent cell do not bar gaseous circulation. Parallel connection is carried out with the heat-resistant conductor of the structure where the separators of an adjacent cell do not bar gaseous circulation. Opening one end of each cell is inserted in the cell insertion hole prepared in the septum which classifies said generator room and said combustion chamber. Shock absorbing material is prepared between each cell and said septum, and an oxidation gas supply line is inserted into said oxidation gas passageway from opening of each cell. The power plant which was constituted so that the oxidation gas of said oxidation gas interior of a room might pass said oxidation gas supply line and said oxidation gas passageway and might flow to said combustion chamber, and was constituted so that the fuel gas of said fuel gas interior of a room might pass said generator room and said cell insertion hole and might flow to said combustion chamber.

[Claim 13] A fuel gas room, an oxidation gas chamber, a generator room, and a combustion chamber are prepared at least in a power plant. Said generator room is classified into a generation-of-electrical-energy field and a preheating field, and a cell according to claim 7 keeps two or more predetermined spacing in said generator room mutually, and is arranged. Under the present circumstances, it is arranged so that the fuel electrode of two or more cells and the sense of opening may become almost the same. Series connection is carried out with the heat-resistant conductor of the structure where the fuel electrode and separator of the cell which adjoins each other in said generation-of-electrical-energy field do not bar gaseous circulation. Parallel connection is carried out with the heat-resistant conductor of the structure where the separators of the cell which adjoins each other in said generation-of-electrical-energy field do not bar gaseous circulation. It fills up with the heat insulator of the structure which does not bar gaseous circulation between the cells which adjoin each other in said preheating field. Said oxidation gas chamber and said preheating field are classified by the airtight septum, and the seal of between this airtight septum and each cell is carried out airtightly. The power plant which is constituted so that the fuel gas of said fuel gas interior of a room may pass through said preheating field and said generation-of-electrical-energy field and may flow to said combustion chamber, and is constituted so that the oxidation gas of said oxidation gas interior of a room may flow to said combustion chamber through said oxidation gas passageway.

[Claim 14] The power plant according to claim 13 constituted so that the hermetic seal between said airtight septa and said cells may be performed in the temperature requirement of 100 degrees C - 500 **.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the power plant which used the cell of a solid oxide fuel cell, and this.
[0002]
[Description of the Prior Art] Recently, the fuel cell attracts attention as a power plant. It is equipment which can transform into direct electrical energy the chemical energy which a fuel has, and diversification of a fuel is possible for naphtha, natural gas, a methanol, coal reformed gas, a fuel oil, etc., it is low pollution, and, moreover, generating efficiency is not influenced [it essentially has a high energy conversion efficiency, and] according to a facility scale, but this is a very promising technique in order not to receive constraint of a Carnot's cycle. Especially, it is a solid oxide fuel cell. (SOFC) 1000 degrees C in order to carry out operating at high temperatures, electrode reaction is very active and does not need the precious metal catalyst of expensive platinum etc. at all, but polarization is small, and since output voltage is also comparatively high, the energy conversion efficiency of polarization is remarkably high compared with other fuel cells. Furthermore, since all structure material consists of solid-states, it is stable and long lasting.
[0003] As mentioned above, SOFC of various structures is proposed from all the components of SOFC being solid-states. These are divided roughly into a monotonous mold and cylindrical (2 energy synthesis engineering 13- 1990). For the electromotive force of the cell of these SOFC(s), it sets to an open circuit and about 1V and current density are also several 100mA/cm2 at most. Since it is extent, it is important to enable it to connect easily to a serial and juxtaposition the cell which has a big generation-of-electrical-energy area in real use. This viewpoint to a cell, and its stack (set cell) Structure must be examined.
[0004] However, in the monotonous mold cel, it was difficult to produce the cell of a large area with a high flat-surface precision from the brittleness of the ceramics. In order to solve this, the method of making a soft ingredient placed between the electrical installation between single cels is proposed (JP,3-55764,A). However, even if it carries out with this approach, there is a limitation in the magnitude of the ceramic plate produced by one, and since structure is complicated, the parallel connection between cells is difficult and cannot expand the amount of output currents easily. Furthermore, it is difficult to perform a gas seal at the edge in the cell of a monotonous mold.
[0005] On the other hand, cylindrical cel of Westinghouse to which the manufacture technique is going most now (2 or energy synthesis engineering 13-1990) It sets, and it is using cylindrical [with structure top reinforcement], the brittleness of the ceramics is eased, and seal loess structure is made possible by making it the structure which stopped one end of a cell further. Furthermore, it excels in the point easily connectable with a serial and juxtaposition using the metallicity felt. However, in this structure, since a current flows in parallel with a solid-electrolyte membrane in an air electrode, a current path is long and the power consumption in this process occurs. In order to solve this, the method of establishing a current path in addition to the hoop direction of a cylinder cross section is proposed (JP,63-261678,A). However, internal resistance of a cel cannot be reduced like the monotonous mold cel which passes a current at right angles [this] to a solid-electrolyte membrane. Moreover, although it is necessary to prepare the nature solid-electrolyte membrane of airtight on a cylinder-like porosity base material by this approach, it is EVD in this case. The production rate was small at altitude, such as law, and the technique in which a manufacturing cost was large needed to be used.
[0006]
[Problem(s) to be Solved by the Invention] The technical problem of this invention is enlarging the amount of generations of electrical energy per unit volume, enabling it to perform a gas seal easily, enlarging reinforcement of a cell, and raising the dependability of a cell and its stack, and enabling it to also perform the manufacture easily.

[0007]
[Means for Solving the Problem] The front face and the crosswise side face of this air electrode are covered. separator; which this invention consisted of an electronic conductor of the substantia compacta, and equips the front face of the crosswise edge of a plate-like plane quadrilateral-like body with the side attachment wall of a pair -- air electrode; joined to said side attachment wall of this separator -- And it has the fuel electrode in which a part of skin of the side attachment wall of said separator was prepared on solid electrolyte [of a wrap and the substantia compacta];, and the front face of this solid electrolyte. A conductive septum is formed in the space surrounded with said plate-like body, side attachment wall of said pair, and said air electrode, an oxidation gas passageway is formed, and said septum is applied to the cell of a solid oxide fuel cell combined to said plate-like body and said air electrode.
[0008] Moreover, in this invention, two or more cells of each other [a generator room] are set and arranged for predetermined spacing on the occasion of carrying out grouping of the above-mentioned cell. Under the present circumstances, it arranges so that the fuel electrode of two or more cells and the sense of opening may become almost the same. Series connection of the fuel electrode and separator of an adjacent cell is carried out with the heat-resistant conductor of the structure which does not bar gaseous circulation. While carrying out parallel connection and being able to supply oxidation gas in the oxidation gas passageway of a cell with the heat-resistant conductor of the structure which does not bar gaseous circulation for the separators of an adjacent cell, it constitutes so that fuel gas can be supplied to the generation-of-electrical-energy interior of a room.
[0009]
[Example]
(Example 1) The example of this invention is explained hereafter, carrying out sequential reference of drawing 1 - drawing 8 . Drawing 2 is the perspective view showing separator 5A. The flat-surface configuration of this separator 5A is a rectangle, and the ratio of the die length of the long side of this rectangle and the die length of a shorter side is two or more.
[0010] 5h of long and slender side attachment walls of a pair is formed in the front face of the crosswise edge of flat-surface rectangle-like plate-like body 5a. 5h of both these side attachment walls is square pole configurations, and they are prolonged toward the other end from the end of the die-length direction of a separator. Between 5h of side attachment walls of a pair, a total of three trains septum 5b of a square pole configuration is mutually formed in parallel toward the other end from the end of the die-length direction. When separator 5A is seen in the die-length direction, square pole-like edge side septum 5c is formed in one edge. Edge side septum 5c is following septum 5b and 5h of side attachment walls. A total of four trains of parallel oxidation gas passagewaies 6 is mutually formed between septum 5b and 5h of side attachment walls. The end of each oxidation gas passageway 6 is blockaded by edge side septum 5c so that it may mention later. Opening of the other end of each oxidation gas passageway 6 is carried out. Almost similarly the height of each septum 5b and edge side septum 5c is set up.
[0011] This separator 5A consists of an electronic conductor of the quality of airtight. Furthermore, since this separator 5A is put to oxidation gas and fuel gas, it must be equipped with oxidation resistance and reducibility-proof. The nickel zirconia cermet which covered with LaCrO3 ceramics the part exposed to LaCrO3 ceramics and oxidization gas as such an ingredient can be illustrated.
[0012] The top view where drawing 3 saw the cell component part from the fuel electrode 2 side, the top view where drawing 4 saw only the cell component part from the air electrode 4A side, and drawing 1 are the sectional views showing the completed cell. The flat-surface configuration of the solid electrolyte plate 3 of the substantia compacta is almost the same as the flat-surface configuration of separator 5A. The flat-surface rectangle-like fuel electrode layer 2 is formed in the front face of the solid electrolyte plate 3.
[0013] Flat-surface rectangle-like air electrode 4A is too formed in the fuel electrode 2 of a solid electrolyte 3, and the front face of the opposite side. In the part in which air electrode 4A does not exist, long and slender projection 3a of a pair and long and slender projection 3b are formed along the periphery of a solid electrolyte 3. These projections 3a and 3b also make some solid electrolytes 3. Crosswise side-face 4a of air electrode 4A is covered with projection 3a, and is not exposed. Edge side side-face 4b of the die-length direction of air electrode layer 4A is also covered with projection 3b, and is not exposed.
[0014] Here, the desirable manufacture procedure of this cell is described. Here, drawing 5 is referred to. Air electrode 4A has desirable LaMnO3 which could manufacture in LaMnO3 which was doped or is not doped, CaMnO3, CaNiO3, and LaCoO3 grade, and added strontium. This air electrode is calcinated so that porosity may become 20 - 35% beforehand, and it is joined to separator 5A prepared separately. In the case of junction, air electrode 4A, septum 5b, 5c, and 5h of side attachment walls are opposed. The ceramic powder layer 8 for junction is formed in septum 5b, 5c, and the front face of 5h of side attachment walls. As for the quality of the

material of the ceramic powder layer 8, the quality of the material of air electrode 4A and the quality of the material of separator 5A is proposed. And each septum 5b, 5c, and 5h of side attachment walls are heat-treated in the condition of having made air electrode 4A contacting, respectively, and the layered product which consists of an air electrode and interconnector (separator) is obtained.

[0015] A solid electrolyte 3 is formed in a configuration which described above the interface of the air electrode of said air electrode 4A and a separator layered product and an air electrode, and a separator to the wrap. A spraying process is proposed as a forming method. The fuel electrode layer 2 is formed in the front face of a solid electrolyte 3 as shown in drawing 3 . Thereby, cell 1A shown in drawing 1 and drawing 6 is producible.

[0016] The end of the oxidation gas passageway 6 is blockaded by edge side septum 5c in this cell 1A. Crosswise side-face 4a of air electrode 4A and 5g of a part of crosswise skins of separator 5A are covered with long and slender projection 3a. Side-face 4b by the side of the edge of the die-length direction of air electrode 4A and a part of skin of edge side septum 5c are covered with long and slender projection 3b. The oxidation gas passageway 6 and the side faces 4a and 4b of air electrode 4A are surrounded with separator 5A and the solid electrolyte 3 which are all the quality of airtight. Therefore, oxidation gas does not leak from other than opening of the oxidation gas passageway 6.

[0017] Next, the example of a configuration of the power plant which comes to gather in the above-mentioned cell is described. drawing 7 turned off such a power plant in the die-length direction of a cell -- it is a sectional view a part. Drawing 8 is the fragmentary sectional view which turned off the power plant of drawing 7 crosswise [of a cell]. The whole power plant is held in the abbreviation rectangular parallelepiped-like can 10. The fuel gas room 18, the generator room 17, the combustion chamber 16, and the oxidation gas chamber 15 are established in the interior of a can 10. Through tube 10c of a can 10 It is open for free passage in the fuel gas room 18, and is through tube 10b. It is open for free passage in the oxidation gas chamber 15, and is through tube 10a. It is open for free passage to a combustion chamber 16.

[0018] The fuel gas room 18 and a generator room 17 are classified by the septum 14. In a septum 14, it is fuel gas feed-holes 14a at fixed spacing. It is prepared. A generator room 17 and a combustion chamber 16 are classified by the septum 12. In a septum 12, it is cell insertion hole 12a at fixed spacing. It is formed. A combustion chamber 16 and the oxidation gas chamber 15 are classified by the septum 11. In a septum 11, it is through tube 11a at fixed spacing. It is formed.

[0019] Each cell 1A is held in a generator room 17, and the edge of cell 1A contacts a septum 14 through insulating ceramic felt material, such as alumina felt. The edge by the side of the opening 8 of each cell 1A is each cell insertion opening 12a. It penetrates and exposes to a combustion chamber 16. Consequently, each oxidation gas passageway 6 is open for free passage with a combustion chamber 16. Cell insertion hole 12a Between the peripheral faces of cell 1A, it is cell insertion hole 12a. The perimeter is covered mostly, the clearance between some is open, and this clearance is filled up with shock absorbing material 13. Consequently, the edge of each cell 1A is loosely held through shock absorbing material 13. As shock absorbing material 13, ceramic felt material, such as alumina felt, is desirable, for example.

[0020] The plate-like collecting electrode plate 19 is installed in the bottom of the generator room 17 of a can 10, and the current collection material layer 20 is formed on the collecting electrode plate 19. By this example, cell 1A is arranged so that fixed spacing may be kept in the vertical direction and a longitudinal direction, respectively and it may extend. However, in drawing 8 , from the constraint on the dimension of a drawing, only three downward trains were illustrated among such set cells, and only two left-hand side trains were illustrated. Of course, the number of cell 1A contained in such a set cell can be chosen suitably.

[0021] Cell 1A of the lowest edge is laid on the current collection material layer 20 in a generator room 17. In order to make the current collection material layer 20 follow in footsteps of deformation [the configuration of cell 1A, or], what has elasticity and plasticity is good. Predetermined spacing is kept, other cell 1A is arranged one by one, and the fuel electrode 2 of up-and-down cell 1A and plate-like body 5a are made to counter on cell 1A of the lowest edge. Among these, it is heat-resistant conductor 21A of an abbreviation monotonous configuration. It inserts and the fuel electrode 2 of cell 1A and plate-like body 5a which adjoined each other in the vertical direction are connected electrically. Moreover, heat-resistant conductor 21B long and slender between cell 1A which adjoins a longitudinal direction in drawing 8 It inserts. This connects separator 5A of cell 1A electrically. Each heat-resistant conductor 21A 21B It is made not to contact.

[0022] Through tube 11a of a septum 11 The supply pipe 9 of the shape of a cylinder which has the almost same bore is fixed to a septum 11 at fixed spacing. The inside space of each supply pipe 9 is through tube 11a, respectively. It minds and is open for free passage in the oxidation gas chamber 15. Each supply pipe 9 crosses a combustion chamber 16, is inserted into the oxidation gas passageway 6 through opening 8, and is supported on plate-like body 5a. The feed hopper which exists at the tip of each supply pipe 9 keeps the distance of edge side septum 5c and a some, and counters.

[0023] Next, actuation of this power plant is described, referring to drawing 7 . oxidation gas -- through tube 10from the outside of can 10 b it lets it pass and supplies like an arrow head A -- having -- the oxidation gas chamber 15 -- a passage -- through tube 11a from -- it is sent into a supply pipe 9 like an arrow head B. Subsequently, this oxidation gas flows the inside of a supply pipe 9 like an arrow head C, and is supplied into the oxidation gas passageway 6 like an arrow head D from a feed hopper. And it collides with edge side septum 5c immediately, the course is changed like an arrow head D, and this oxidation gas flows between air electrode 4A and supply pipes 9, and is discharged from opening 8 to a combustion chamber 16.
[0024] On the other hand, fuel gas is through tube 10c like the exterior of a can 10 to the arrow head E. It passes, is supplied into the fuel gas room 18, and is fuel gas feed-holes 14a further. It passes and is supplied in a generator room 17 like an arrow head F. And it mainly passes in heat-resistant conductor 21A and 21B, it passes through shock absorbing material 13 like an arrow head G further, and is discharged in a combustion chamber 16. At the time of actuation of a power plant, oxidation gas produces oxygen ion etc. in the interface of air electrode 4A and a solid electrolyte 3, and while these oxygen ion etc. moves to the fuel electrode 2 through a solid electrolyte 3 and reacts with fuel gas, an electron is emitted to the fuel electrode 2. And the potential difference arises between air electrode 4A which is a positive electrode, and the fuel electrode 2 which is a negative electrode. such a cell -- said -- it carried out -- as -- series connection -- parallel connection is carried out and, finally power is taken out from a collecting electrode plate 19.
[0025] Between the generator room 17 and the combustion chamber 16, it is designed so that the flow of fuel gas may arise to a combustion chamber 16 in slight differential pressure, and the back flow to a generator room 17 is protected from the combustion chamber 16. A steam, carbon dioxide gas, etc. which were generated by the reaction are contained in the fuel gas which passed through the generator room 17, and the fuel content is also decreasing. This decreased fuel gas burns in the ****** gas decreased similarly and a combustion chamber 16. With this heat of combustion, the preheating of the fresh oxidation gas which is flowing the inside of a supply pipe 9 can be carried out. through tube 10a from -- a combustion gas is discharged like an arrow head H. As fuel gas, the gas containing fuels, such as hydrogen, reforming hydrogen, a carbon monoxide, and a hydrocarbon, is used. The gas containing oxygen is used as oxidation gas.
[0026] According to this example, the following effectiveness can be done so.
(1) cylindrical [which is SOFC said for practicality to be for example, present the highest since cell component 7A is plate-like / SOFC] (Provisional Publication No. 57-11356 number official report etc.) It compares, and it can be markedly alike, generation-of-electrical-energy area can be enlarged, and the amount of generations of electrical energy per unit volume can be increased.
[0027] (2) In case a solid electrolyte 3 is fabricated, a plasma metal spray method can be used. That is, it is EVD about a solid electrolyte like [in the case of manufacturing a cylindrical cell]. It is not necessary to prepare. Therefore, compared with such a conventional method, the productivity of a solid-electrolyte membrane can be raised and cost can be lowered. At such semantics, the thickness of a solid electrolyte 3 is 10 micrometers. It is 500 above. mum Considering as the following is desirable and it is 50 micrometers. It is 100 above. mum It is still more desirable when it is the following.
[0028] (3) Septum 5b is prepared in separator 5A, and each septum 5b is connected with air electrode 4A. since the current path which passes along air electrode 4A to septum 5b occurs by this, the distance which flows to the film and parallel boils the inside of air electrode 4A markedly, and it is shortened. Since the internal resistance in this result, especially air electrode 4A is reduced, a cell output improves.
[0029] (4) As mentioned above, since each septum 5b is joined to the plate-like cell component, structure reinforcement is large. Therefore, dependability became high, even if were seen on the level of a cell and having been seen on the level of a set cell. This reason is that cell 1A is equipped with multichannel structure, i.e., structure which made some small square tubed parts coalesce, and is using the precise ceramics etc. as the substantial base material.
[0030] (5) As mentioned above, make the pressure of a generator room 17 larger than the pressure of a combustion chamber 16, and pass fuel gas to an one direction. Moreover, it is passing from the oxidation gas passageway 6 in one direction to the combustion chamber 16 also about oxidation gas. Therefore, it is cell insertion hole 12a about 4 rounds of cell 1A. It is not necessary to set and to carry out a seal airtightly and rigid. For this reason, there is little generating of the distorted stress which originates in immobilization and a seal at cell 1A, and the dependability as the structure improves.
[0031] (6) Moreover, heat-resistant conductor 21A which does not bar gaseous circulation, 21B, and shock absorbing material 13 are performing maintenance and positioning of each cell 1A softly. Thereby, even if cell 1A carries out thermal expansion, the stress concerning cell 1A becomes still smaller.
[0032] (7) Since the generator room 17 is formed between the fuel gas room 18 and the combustion chamber 16, oxidation gas contacts waste fuel gas with many already decreased steams in a combustion chamber 16.

Therefore, combustion and generation of heat local and rapid [the opening 8 neighborhood] do not occur. Therefore, there is no possibility that a crack may arise at the cell edge in connection with this.
[0033] (Example 2) Drawing 9 is the same sectional view as drawing 1 which cut other cell 1B crosswise. Among these, the configuration of a solid electrolyte 3 and the fuel electrode layer 2 and the manufacturing method are the same as an example 1. About air electrode 4B and separator 5B, a configuration differs from an example 1. That is, 5h of side attachment walls is prepared in both the edges of the cross direction of plate-like body 5a of separator 5B, respectively. Moreover, septum 4c of two or more trains is prepared in air electrode 4B. By joining these, the oxidation gas passageway 6 is formed between adjacent septum 4c between 5h of side attachment walls, and septum 4c, respectively. The configuration of other parts of cell 1B which has such a crosswise cross section can be made the same as the configuration of cell 1A.
[0034] (Example 3) In this example, the new set gestalt of the cell of the type in which the oxidation gas passageway is carrying out opening in both directions, and such a cell is explained. Drawing 10 is the perspective view showing separator 5C, and drawing 11 is the sectional view which cut and looked at cell 1C in the die-length direction.
[0035] In this separator 5C, 5h of side attachment walls of a pair and septum 5b of for example, three trains are mutually formed in the front face of plate-like body 5a in parallel. In this example, each septum 5b and 5h of side attachment walls are prolonged from the end of the die-length direction of separator 5C to the other end. Each of each septum 5b is square pole configurations, and the oxidation gas passageway 6 of a square pole configuration is too formed for all between septum 5b and 5h of side attachment walls. Each oxidation gas passageway 6 is prolonged in the shape of a straight line from the end of the die-length direction of separator 5C to the other end. In drawing 10, 24 shows the preheating field mentioned later and 25 shows the generation-of-electrical-energy field mentioned later.
[0036] Air electrode 4A is equipped with the almost same flat-surface configuration as separator 5C, and is joined to septum 5b and the front face of 5h of side attachment walls. A solid electrolyte 23 is formed in the front face of air electrode 4A, and the fuel electrode 2 is formed in the front face of a solid electrolyte 23. The crosswise cross-section configuration of this cell 1C is the same as cell 1A shown in drawing 1 . In the both ends of the die-length direction of cell 1C, the oxidation gas passageway 6 is carrying out opening. Although air electrode 4A is covered with a solid electrolyte 23 in the cross direction of separator 5C (it is the same as drawing 1), it is not covered with a solid electrolyte 23 in the both ends of the die-length direction of separator 5C. Since it exposes to an oxidation gas chamber or a combustion chamber, these opening parts do not need to cover the front face of porous air electrode 4A with a substantia-compacta ingredient.
[0037] Drawing 12 is the sectional view showing some power plants which come to gather in such a cell 1. From constraint of the dimension of a drawing, only three lower trains are illustrated among these power plants in drawing 12.
[0038] To the side attachment wall in which the can 30 of the abbreviation rectangular parallelepiped configuration which consists of a substantia-compacta ingredient carries out phase opposite, it is through tube 30a. 30b It is prepared. In a drawing, the fuel gas room 37, the oxidation gas chamber 38, a generator room 40, and a combustion chamber 39 are established in the interior of this can 30 in an order from right-hand side. The fuel gas room 37 and the oxidation gas chamber 38 are classified by the airtight septum 33, the oxidation gas chamber 38 and a generator room 40 are classified by the airtight septum 34, and the generator room 40 and the combustion chamber 39 are classified by the septum 36.
[0039] A generator room 40 is divided into the preheating field 24 and the generation-of-electrical-energy field 25. The preheating field 24 is in a septum 34 side, and the generation-of-electrical-energy field 25 is in a septum 36 side. A supply pipe 31 crosses the fuel gas room 37, and the building envelope of a supply pipe 31 is open for free passage in the oxidation gas chamber 38. In the airtight septum 34, it is through tube 34a. Cell insertion hole 34b It is formed. The supply pipe 32 is crossing the oxidation gas chamber 38, and the building envelope of each supply pipe 32 is open for free passage in the fuel gas room 37. The bore of each supply pipe 32 is through tube 34a. It is almost the same as a bore, and each supply pipe 32 is through tube 34a. Alignment is carried out. Each through tube 34a The preheating field 24 is faced.
[0040] Cell insertion hole 34b The configuration and the dimension are almost the same as the configuration of the cross direction of cell 1C, and a dimension. On account of the drawing display, in drawing 12, a sectional view is shown about one cell 1C, and the front view is shown about two cell 1C. For this reason, it sets to drawing 12 and is through tube 34b. A cross section shows one inside and the dotted line has shown other two. Each cell insertion hole 34b Through tube 34a It is prepared regularly in between. Also to a septum 36, it is cell insertion hole 36a. Predetermined spacing is kept and it is prepared regularly. Each cell insertion hole 36a The dimension is large a little rather than the crosswise dimension of cell 1C.
[0041] The end of each cell 1C is cell insertion hole 34b. It is inserted in inside and the other end is inserted in

cell insertion hole 36a. Thereby, it is built over each cell 1C among septa 34 and 36. Cell 1C and cell insertion hole 34b The seal of in between is carried out airtightly, and it must be made for neither fuel gas nor oxidation gas to have to leak from here. In order to perform such a hermetic seal, the approach of stopping the clearance between both members by organic resin, using a gasket is proposed.
[0042] Cell insertion hole 36a Between a peripheral surface and the periphery of cell 1C, it is cell insertion hole 36a. The perimeter is covered and there is a clearance between some. This clearance is filled up with the shock absorbing material 13 which does not bar gaseous circulation. In the drawing of cell 1C, a left-hand side edge is loosely supported by the septum 36 through shock absorbing material 13.
[0043] In the preheating field 24, the space between each cell 1C which adjoins the vertical direction and a longitudinal direction is filled up with the permeability heat insulator 35. Therefore, these heat insulators 35 function also as a charge of supporting material of a cell.
[0044] In the generation-of-electrical-energy field 25, it has the same composition as what was shown in drawing 8 . That is, the fuel electrode 2 of cell 1C and separator 5C which adjoined each other in the vertical direction are electrically connected by heat-resistant conductor 21A. Separator 5C of cell 1C of the lowest edge is heat-resistant conductor 21A. It minds and is collecting electrode plate 19A. It connects electrically.
[0045] Actuation of this power plant is explained. fuel gas -- through tube 30a from -- it is supplied like an arrow head I in the fuel gas room 37, and is sent in like an arrow head J in a supply pipe 32. Subsequently, this fuel gas is a supply pipe 32 and through tube 34a. It passes and passes through the preheating field 24, and the generation-of-electrical-energy field 25 is flowed further, shock absorbing material 13 is passed like an arrow head K, and it goes into a combustion chamber 39.
[0046] On the other hand, oxidation gas passes through the inside of a supply pipe 31 like an arrow head L, enters in the oxidation gas chamber 38, and subsequently, as an arrow head M shows, it flows in the oxidation gas passageway 6. And this oxidation gas carries out sequential passage of the preheating field 24 and the generation-of-electrical-energy field 25, and flows out in a combustion chamber 39 like an arrow head N. In a combustion chamber 39, the decreased fuel gas and the decreased oxidation gas burn. through tube 30b from -- a combustion gas is discharged like an arrow head P.
[0047] (1) stated in the example 1 also in the cell and power plant concerning this example The effectiveness of - (7) can be done so. However, in this power plant, the right-hand side edge is fixed rigid in drawing 12 of cell 1C.
[0048] Furthermore, in cell 1C used for an important thing by this example, the end of the oxidation gas passageway 6 is not stopped, but the both ends are carrying out opening. And separator 5C has comparatively easily the form which can be fabricated by extrusion molding etc. Temporarily, if the end of the oxidation gas passageway 6 shall be stopped, such ceramic processing will be difficult and it will become quite difficult to give sufficient reinforcement for the stopped part. For this reason, from the point of industrial engineering, cell 1C is very advantageous.
[0049] Moreover, it became possible to carry out grouping of cell 1C, and to operate it by offering the power plant of a configuration as shown in drawing 12. Since the power plant of such a configuration is very characteristic, the operation etc. is explained in more detail. The important thing in operating a solid oxide fuel cell is separating fuel gas and oxidation gas. For that, the seal of each part material must be carried out airtightly. In order to perform such a hermetic seal, there is an approach using a gasket, an organic sealing agent, etc.
[0050] However, the temperature of the generation-of-electrical-energy interior of a room goes up also to 1000 degrees C at the time of actuation. It is difficult to use the above airtight sealants for the bottom of such an elevated temperature. such an airtight sealant -- at most -- about 500 ** -- **** -- it is because it cannot bear. For this reason, in the power plant of structure as shown in drawing 7 , the seal loess structure which made the above hermetic seals unnecessary is adopted. In order to realize such seal loess structure, edge side septum 5c must stop the end of cell 1A.
[0051] Unlike this, in the power plant of this example, an airtight seal is carried out between a septum 34 and the edge of cell 1C. In a septum 36 side, in order to pass fuel gas, a hermetic seal does not give. Under the present circumstances, in the generation-of-electrical-energy field 25, it becomes an about 1000-degree C elevated temperature. Then, the heat insulator 35 has been arranged between a septum 34 and the generation-of-electrical-energy field 25, and the preheating field 24 was formed in it. Of course, in the preheating field 24, temperature falls quickly as a septum 34 is approached. In order to perform the above hermetic seals in a septum 34, temperature of this seal part must be considerably made into low temperature preferably rather than the inside of the generation-of-electrical-energy field 25 below at 500 **. Furthermore, the selection kind of the sealant made of resin spreads below in 350 **. However, in order to carry out to below 100 **, it will be necessary to lengthen the preheating field 24, and the amount of generations of electrical energy per unit

volume will become less. Therefore, 100 - 350 ** is the most desirable range. On the other hand, while [this] passing through the preheating field 24, both the preheatings of fuel gas and the oxidation gas will be carried out.

[0052] In this example, the quality of the material of a heat insulator 35 has the desirable following. A porosity alumina block, the things which piled up the alumina felt, or these complex. At the above-mentioned example, it is cell insertion hole 34b about the edge of cell 1C. It inserted in. However, the end side of cell 1C may be made to contact the airtight septum 34, and the seal of between both may instead be carried out airtightly. However, it is necessary to prepare the hole for oxidation gas in the airtight septum 34 also in this case.

[0053] In the cell shown in drawing 11, no obstructions are prepared in the oxidation gas passageway 6. However, in the preheating field 24, oxidation gas is not consumed for a generation of electrical energy. Then, as shown in drawing 13, it can be filled up with the heat insulator 26 of permeability in the preheating field 24. As such a heat insulator 26, a ceramic porous body, a ceramic fiber, etc. are desirable. By filling up the preheating field 24 with the heat insulator 26 of permeability, the high temperature in the generation-of-electrical-energy field 25 can be absorbed effectively, adiabatic efficiency can be raised, and the temperature of a hermetic-seal part can be reduced further. While oxidation gas passes the heat insulator 26 which absorbed heat with this, the preheating of the oxidation gas can be carried out much more effectively. It is because the distance in which oxidation gas flows becomes long compared with the case where there is no heat insulator 26.

[0054] Moreover, separator 5D as shown in drawing 14 can also be used. In this separator 5D, 5h of side attachment walls of a pair is mutually formed in the front face of both the edges of the cross direction of a separator in parallel. In the generation-of-electrical-energy field 25, 5d of septa of the shape of the square pole of a total of three trains is mutually formed in parallel toward the die-length direction of a separator inside 5h of side attachment walls of a pair. In this generation-of-electrical-energy part, the oxidation gas passageway 6 is 4 successive-installation eclipse ****** in parallel mutually.

[0055] In the preheating field 24, the oxidation gas passageway is crooked intricately. First, a total of 5f of three trains of septa of the square pole configuration prolonged crosswise [of separator 5D] first is formed toward the direction of a generation-of-electrical-energy field from the end of separator 5D, in view of the entrance side of the preheating part of a cell. It receives mutually, and 5f of each septum is parallel, and it is perpendicular to the die-length direction of separator 5D. The end of 5f of each septum is united with either of the 5h of the side attachment walls of a pair, and the other end has left the clearance between some [5h of side attachment walls, and]. Oxidation gas-passageway 6A is formed between 5f of septa of a triplex row. This oxidation gas-passageway 6A moves in a zigzag direction greatly between 5h of side attachment walls.

[0056] Among Septa 5f and 5d, total [of four rectangular parallelepipeds]-like septum 5e is formed. Septum 5e with small width of face of a total of four pieces is uniting a list and 2 of these with 5h of side attachment walls toward the cross direction of separator 5D at the single tier, respectively. Between septum 5e, short paddle oxidation gas-passageway 6B is formed in a total of three places.

[0057] In this example, in the preheating field 24, an oxidation gas passageway winds, and since it is crooked, compared with the case where an oxidation gas passageway is a straight line-like, the **** distance of oxidation gas becomes quite long. Therefore, the preheating of oxidation gas can be performed effectively. However, since extrusion molding etc. is inapplicable to separator 5D as shown in drawing 14, at the point of productivity, it becomes and falls [the thing of drawing 13].

[0058] In the above-mentioned example, the flat-surface configuration used the rectangular cell. However, the flat-surface configuration of a cell may be made into a parallelogram. As for the ratio [as opposed to the die length of that shorter side in this case] of the die length of a long side, considering more than as twice is desirable. The cross section which cut each oxidation gas passageway crosswise [the] is 2 0.01-2cm. Carrying out is desirable. For this, the cross section is 2 0.01cm. In below, it is because it becomes difficult to form oxidation gas installation tubing. On the other hand, it is 2 2cm. Above, since the oxidation gas volume in a cell is large, it is for the need of introducing a lot of oxidation gas beyond the need to arise.

[0059] As for the heat-resistant conductor which does not bar gaseous circulation, it is desirable to consider as the sponge-like matter which considers as the felt-like matter which knit and made the heat-resistant metal fiber, or has many open pores. As these quality of the materials, nickel is desirable. What is necessary is to fabricate, and just to knead and calcinate heat-resistant metal powder, a foaming agent, and a binder, in order to produce the above-mentioned sponge-like matter.

[0060]

[Effect of the Invention] according to this invention, since a cell component is plate-like, compared with cylindrical [SOFC], it can be markedly alike, generation-of-electrical-energy area can be enlarged, and the amount of generations of electrical energy per unit volume can be increased. moreover -- since a solid

electrolyte can be fabricated by a spraying process etc. -- EVD etc. -- compared with cylindrical [with the need of using and forming a solid-electrolyte membrane / SOFC], the productivity of a solid electrolyte can be raised and cost can be lowered.

[0061] Furthermore, the side attachment wall of a pair is prepared in the separator which consists of an electronic conductor of the substantia compacta, an oxidation gas passageway is formed among these, with the air electrode, an oxidation gas passageway is covered and the air electrode is joined to the side attachment wall of said pair. And the conductive septum is combined to the plate-like body and the air electrode. since the current path which passes along a septum from an air electrode occurs by this, the distance which flows to the film and parallel boils an air electrode markedly, and it is shortened. Since the internal resistance in this result, especially an air electrode is reduced, a cell output improves. And since the septum is joined to the plate-like cell component in addition to the side attachment wall of a pair and the septum was also formed with the precise ingredient, compared with the conventional monotonous mold SOFC, the structure reinforcement of a cell improved by leaps and bounds, and the dependability as a stack also increased.

[Translation done.]

* NOTICES *

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2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the sectional view which cut cell 1A crosswise and looked at it.
[Drawing 2] It is the perspective view of separator 5A.
[Drawing 3] It is the top view which looked at the cell component part from the fuel electrode 2 side.
[Drawing 4] It is the top view which looked at the cell component part from the air electrode 4A side.
[Drawing 5] It is the sectional view showing the condition before joining air electrode 4A and separator 5A.
[Drawing 6] It is the sectional view showing the circumference of the lock out edge of cell 1A.
[Drawing 7] It is a sectional view a part having trying to turn off some power plants in the die-length direction of a cell.
[Drawing 8] It is the sectional view which turned off and looked at some power plants of drawing 7 crosswise [of a cell].
[Drawing 9] It is the sectional view which cut other cell 1B crosswise and looked at it.
[Drawing 10] It is the perspective view showing separator 5C.
[Drawing 11] It is the sectional view which cut and looked at cell 1C in the die-length direction.
[Drawing 12] It is a sectional view a part having trying to turn off some other power plants in the die-length direction of cell 1C.
[Drawing 13] It is the perspective view showing the condition of having been filled up with the heat insulator 26 of permeability in the oxidation gas passageway of separator 5C.
[Drawing 14] It is the perspective view showing separator 5D.
[Description of Notations]
1A, 1B, 1C Cell
2 Fuel Electrode
3 23 Solid electrolyte
4A, 4B Air electrode
4a The crosswise side face of an air electrode
4b The side face by the side of a edge
5A, 5B, 5C, 5D Separator
5a Plate-like body
4c, 5b, 5 d, 5e, five f Conductive septum
5c Edge side septum
5g Skin of the side attachment wall of a separator
5h Side attachment wall of a pair
6, 6A, 6B Oxidation gas passageway
8 Opening
9 Oxidation Gas Supply Line
10 30 Can
11, 12, 14, 33, 34 Airtight septum
13 Shock Absorbing Material
15 38 Oxidation gas chamber
16 39 Combustion chamber
17 40 Generator room
18 37 Fuel gas room
21A, 21B Heat-resistant conductor
24 Preheating Field
25 Generation-of-Electrical-Energy Field

26 Heat Insulator of Permeability
A, B, C, D, L, M, N Flow of oxidation gas
E, F, G, I, J, K Flow of fuel gas
H, P Flow of a combustion gas

[Translation done.]

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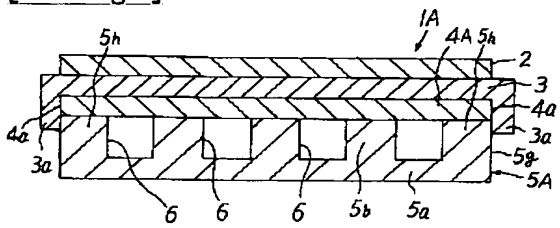
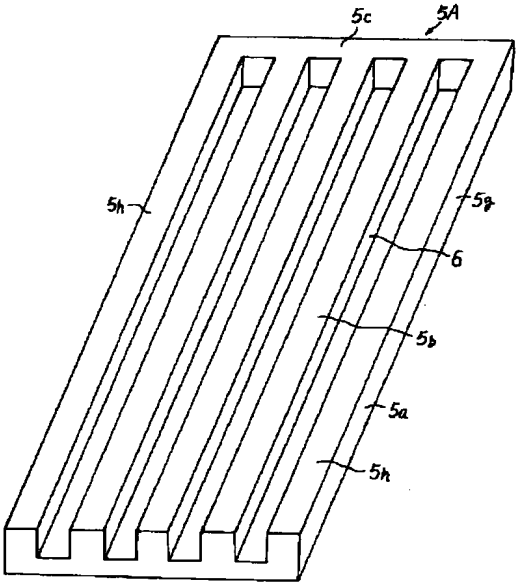
DRAWINGS

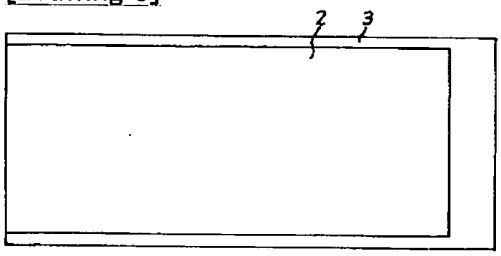
[Drawing 1]



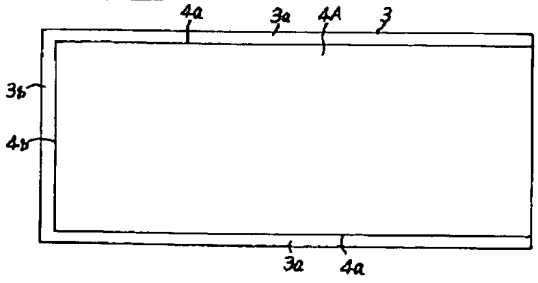
[Drawing 2]



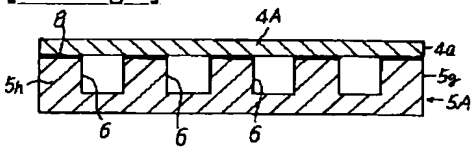
[Drawing 3]



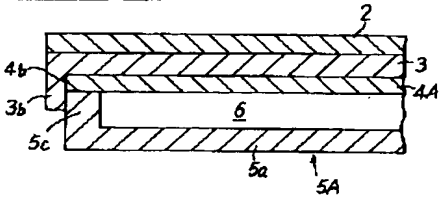
[Drawing 4]



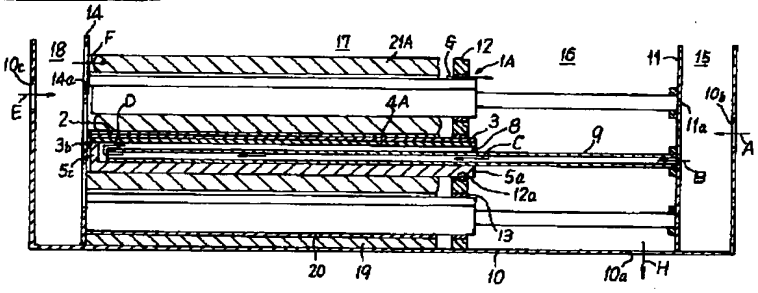
[Drawing 5]



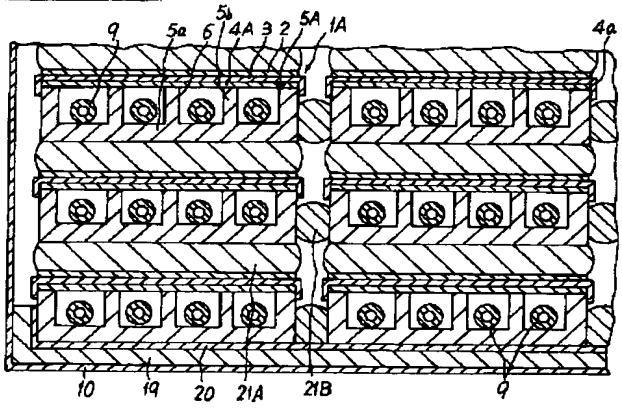
[Drawing 6]



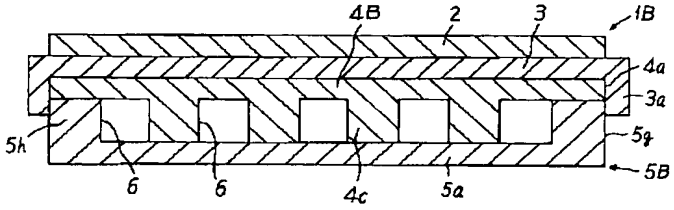
[Drawing 7]



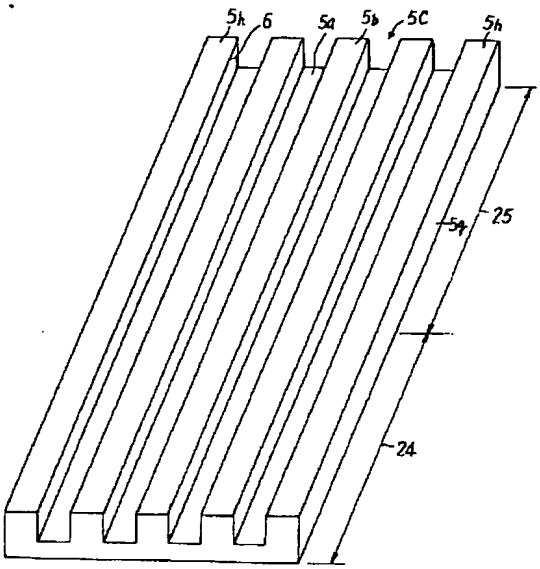
[Drawing 8]



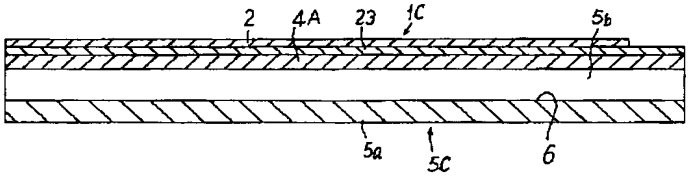
[Drawing 9]



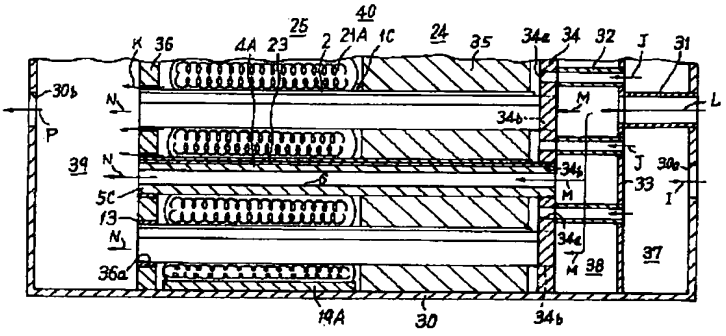
[Drawing 10]



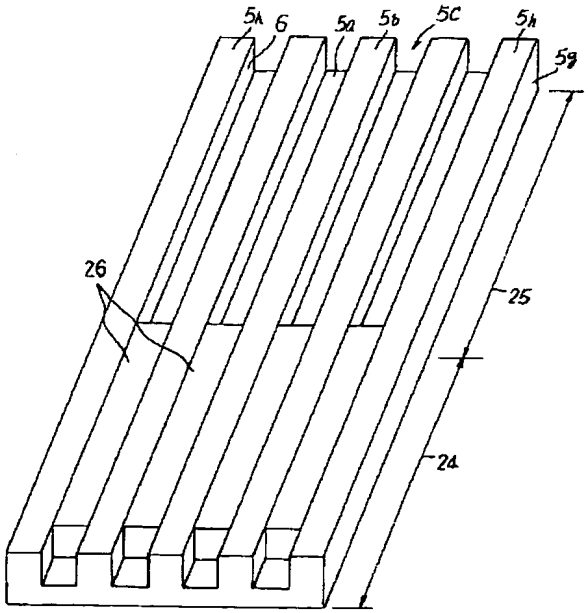
[Drawing 11]



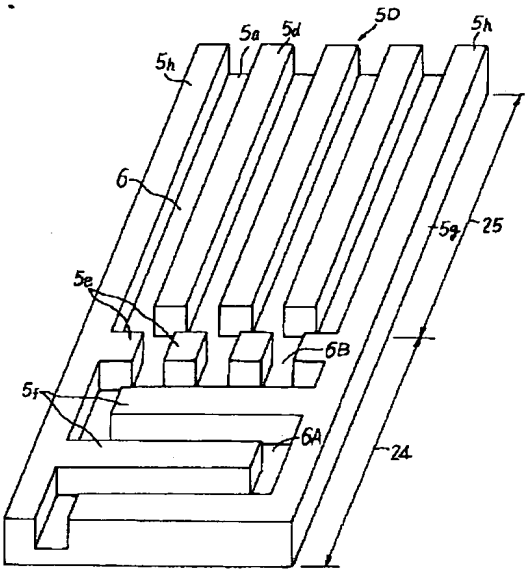
[Drawing 12]



[Drawing 13]



[Drawing 14]



[Translation done.]